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ONTARIO

Department of Education

Courses of Study

Grades IX and X

GENERAL SCIENCE

AND

AGRICULTURAL SCIENCE

Issued by Authority of
The Minister of Education

COURSES OF STUDY

FOR

Grades IX and X (Forms I and II Lower School and Fifth Classes)

IN

Collegiate Institutes, High, and Continuation Schools
Public and Separate Schools, Vocational Schools (Grade IX only)

GENERAL SCIENCE

Objectives:

(a) to arouse, encourage and utilize curiosity in natural objects and phenomena, in order to develop an understanding of the elementary facts of nature;

(b) to cultivate discriminating observation, and the ability to carry observation to a logical conclusion;

(c) to cultivate precise and orderly expression;

(d) to develop an appreciation of nature;

(e) to help towards rational and healthy living.

The realization of these objectives demands active participation by the student. It is suggested that this may be achieved by the adoption of the problem method in which experimental work is undertaken as a means of solving a specific problem which has emerged from class discussion.

The experiment itself should be co-operative. Whenever possible the class should have a part in the assembling and use of the apparatus. From the results of experiments a general conclusion should be deduced and its application developed.

The subject matter of the syllabus has been arranged so as to adhere as far as possible to the natural division into biology on the one hand and the closely related sciences of physics and chemistry on the other. Indeed the Ontario climate practically forces such an arrangement on the teacher, even if he were inclined to break through the boundaries between the special sciences. It is recognized however, that the details of content given below can be arranged in as many ways as there are teachers.

Some may wish to make greater use of the "unit" or "topical" plan than is suggested in the syllabus, feeling that such a method follows the growing interests of the pupils. The topics lend themselves to such a development.

A time allotment is given for each topic merely to indicate the "depth" of treatment intended. Some teachers may wish to treat certain topics more intensively than is suggested in the outline and may therefore not be able to cover all of the work in the time allowed. In order to give the teacher this latitude some topics have been marked as optional but it is hoped that it may be found possible to include even these. In no case, however, should scientific methods of teaching be sacrificed to cover every detail of the course.

GRADE IX

OUTLINE OF THE COURSE (Grade IX)

Note: Topics marked with an asterisk (*) are optional.

Autumn and Early Winter

The relationship of plants to man. (One period.)

A preliminary discussion which will serve to arouse the pupils' interest in botany.

The living plant. (One period.)

Observation of the plant in its natural environment should precede class-room study. Variation in habit and the conditions (light and water) in which the plant grows should be noted.

The shoot and the root. (One period.)

The arrangement of leaves with relation to light; origin of flowers and branches from buds in the axils of leaves; general functions of flower, leaf, stem and root.

The parts of a flower and their functions. (Six periods.)

The shape and arrangement of the parts of two simple flowers, one with separate petals (e.g., buttercup, mustard), one with united petals (e.g., toad-flax, petunia).

Recognition that a composite flower is a group of florets each with united petals.

A hand lens and a needle should be used in examining the stamens, pollen grains, pistil and ovules. (The use of scientific terms in reference to the relationship of parts is not expected).

Pollination and fertilization. (Four periods.)

Insect pollination and wind pollination; floral structure, nectar, abundance of pollen, colour, odour, etc.

Examination of the bee to discover adaptations for the collection of pollen and nectar.

Simple explanation of fertilization.

Fruit and seed. (Six periods.)

A study of the bean fruit, including seed, to show the parts, their origin and their relationship to other parts of the plant and to the propagation of the plant.

A study of simple fleshy fruits such as the tomato, plum and apple. (Classification not expected).

Adaptations of plants for fruit and seed dispersal.

Weeds. (Two periods.)

Recognition of at least ten common weeds mentioned in the Weed Control Act; sight identification of these should be acquired by field trips or study of specimens collected by the pupils.

Winter

Preliminary discussion of relation of water to plant and animal life. (Two periods.)

Widespread distribution of water.

Experiment to show water in plant tissue and in animal tissue.

Water as necessary to plant and animal life.

Water as a habitat for plants and animals.

Brief discussion of water conservation

GRADE IX

Water in various states.
(Four periods.)

Solids, liquids, gases.

Freezing of water, melting of ice and snow.

Observation of snow crystals or other crystals grown by the class as a home assignment.

Experiment to show steam from boiling water and condensation on a colder surface.

Experiment to show evaporation of water.

Formation of dew.

* Frosting of windows and appearance of hoar (white) frost to illustrate sublimation.

* Experiment to show sublimation with benzoic acid.

Importance of water as a solid.
(One period.)

Value of snow as a protecting cover for plants and as a means of water storage in nature.

Experiment to show expansion of water on freezing, as a home assignment; application to floating of ice and to disintegration of rocks and formation of soil.

Importance of water as a gas.
(Two periods.)

Experiment to show presence of water vapour in the atmosphere.

Experiment to show great expansion of water on vaporization: reference to the steam engine.

Water as a solvent.
(Four periods.)

Distilled and ordinary water; an experimental illustration of the separation of water and dissolved solids by distillation.

Solution: experimental illustration of the relative solubility of solids.

* Saturated solutions.

The dissolving of air in water and its significance to aquatic life.

The cause of hardness in water.

An experimental illustration of the behaviour of hard water with soap.

Thermometers.
(Three periods.)

Thermal expansion of matter in each of its three states.

Experiment to show thermal expansion of liquids.

Thermal expansion of liquids as a means of measuring change in temperature.

Use of freezing point and boiling point of water as fixed points in establishing a thermometric scale.

Compare Fahrenheit and Centigrade scales by reading temperatures in both scales.

Compare alcohol and mercury thermometers.

Clinical thermometers.

GRADE IX

Practice in measurement with metric units.
(Four periods.)

Measurement of length in metres, centimetres, and millimetres: comparison of the kilometre and the mile.

The measurement of the area of a rectangular card and of the volume of a rectangular solid.

The measurement of the volume of a liquid.

* Proper use and care of the balance.

Measurement of the mass of a solid by use of a balance.

Density.
(Two periods.)

Meaning.

Density of the solid used above.

Experimental determination of density of water.

Importance in nature of maximum density of water.

* Experimental demonstration of density of mercury.

Municipal water supply.
(Three periods.)

How water is brought to the home from its source.

An elementary study of the supply, purification and use of water in an urban or rural municipality.

* Sand filtration:

(a) Clarification: the effect upon the grains of sand in the bed of adding aluminium sulphate (filter alum).

An experimental illustration of the clarification of a clay suspension: the explanation not to involve chemical formulae.

(b) Detention of bacteria: Reference to harmful bacteria.

* Chlorination: an explanation of its purpose (not to involve chemical formulae).

Pressure in liquids.
(Two periods.)

Experiment to show that water exerts pressure.

Experiment to show that the pressure varies with the depth.

Experiment to show that the pressure is equal in all directions.

Recognition that the weight of a body is a force and that the pressure is due to weight.

The composition of water.
(One period.)

* The analysis of water by electrolysis to show that it is composed of two gases identified as oxygen and hydrogen.

The composition of air.
(Four periods.)

An experiment to show the rusting of iron in damp air; the properties and identity of the fraction of air removed and the fraction remaining.

Experimental illustration that atmospheric oxygen is necessary for combustion.

GRADE IX

Experimental illustration of the production of carbon dioxide by (a) combustion of charcoal (carbon) in air, (b) respiration.

Demonstration of such properties of carbon dioxide as density, and effect upon a flame.

Importance of air. (One period.)

The atmosphere.

Air in soil.

Air in water

The resistance of air to moving bodies.

Air pressure. (Three periods.)

Experiments to show that air occupies space and that air has weight.

Experiment to show that air exerts pressure.

Utilization of air-pressure as shown in such devices as fountain pen, common water-pump, and siphon (mechanical details of these not expected).

Measurement of atmospheric pressure. (Three periods.)

Construction of the mercury barometer.

Variation from day to day and from place to place.

* The height of a water barometer.

Observation of the aneroid barometer with practice in making readings.

Its use to measure altitude shown by taking readings at different levels.

Compression and expansion of gases. (Two periods.)

Experimental demonstration.

Elementary discussion of the relationship of volume and pressure.

Compression of air in the bicycle or automobile tire, air-pump, air-gun, air tools, sand-blast (mechanical details not required).

Convection in liquids. (Two periods.)

Thermal expansion.

Experiment to show convection currents in water.

Hot-water heating system (simple notion of circulation only).

Convection in gases. (Three periods.)

Experiment to show convection in air.

Air movement as illustrated in a hot-air heating system, in a heated room, and in a refrigerator: draught in a chimney.

Importance of ventilation

Effects of water in motion. (One period.)

Rain-wash.

River-erosion.

Wave erosion.

GRADE IX

Deposition of sediment.

Effects of air in motion. (Two periods.)

Sailing ships, windmills

Soil drifting.

Sand dunes.

Rainfall and wind.

The work of the Meteorological Service. (Three periods.)

Isobars.

Relation of winds to isobars.

Weather maps.

High and low pressure areas with their winds and weather.

Spring and Early Summer

Examination of leaf epidermis, including stomata.

Structure and function of the leaf. (Nine periods.)

Examination of a cross-section of a leaf to show arrangement of the cells and cell structure.

Experiment to show the iodine test for starch.

Experiment to show that starch is made in green leaves in the light and disappears in the dark.

Experiment to show the presence of starch in seeds and tubers, etc.

The use of an aquatic green plant to show the exhalation of oxygen in bright light; the need for carbon dioxide in the process, e.g., comparison of effect with (a) boiled water, (b) boiled water with carbon dioxide added.

Experiment to show transpiration in green plants.

Growth, structure, and function of the stem. (Four periods.)

A study, over a period of time, of a growing bean plant or of green twigs with opening buds to show the increase in length due to primary growth at or near the tip.

Examination of a green twig to show (a) the location and nature of the cambium layer, (b) that in the older part of the twig there is a greater thickness due to the activity of the cambium (secondary growth).

Examination of a cross-section of oak or other tree trunk to discover: pith, heartwood, sapwood, rays, cambium, outer and inner bark.

Demonstration of the rise of water in stems.

Absorption by roots. (Five periods.)

Experiment to show the presence of mineral salts in solution in soil water.

Observation of the development of root hairs in germinating seeds.

GRADE IX

* Demonstration of diffusion of a gas in air and of a dissolved salt in water.

Simple experiments illustrating the absorption of water with salts in solution through membranes and the significance of this in absorption by roots.

Plant propagation, practical application. (Five periods.)

Means of controlling transpiration in the transplanting of seedlings, shrubs, trees.

* Vegetative reproduction as shown in the growing of strawberry, potato, raspberry, geranium (from slips), etc.

Pruning of trees; removal of buds and its effect on the growth of the plant.

* Grafting and budding in trees and shrubs.

REFERENCE BOOKS

General Science, Book I.....J. M. Dent & Sons Ltd.

A Junior Science for Secondary Schools, Part I Sir Isaac Pitman & Sons Ltd.

Elements of Physics.....The Copp Clark Co. Ltd.

Chemistry for High Schools.....W. J. Gage & Co.

Chemistry Manual.....W. J. Gage & Co.

Everyday Problems in Science.....W. J. Gage & Co.

Science in Daily Life.....Longmans Green & Co.

A Book of General Science.....The Macmillan Co. Ltd.

The World of Science.....The Ryerson Press

GRADE X

OUTLINE OF THE COURSE

Note: Topics marked by an asterisk (*) are optional.

Fundamental functions of plants and animals. (One period).

Manufacture of food by plants; dependence of animals on plants for food and oxygen; use by plants of carbon dioxide produced by animals.

Animals in relation to man's interests. (Two periods).

Various forms of animal life; domesticated animals; value of wild animals. Reference to economic importance of insects.

Insects

Habits, structure and life history. (Ten periods).

A study of the living grasshopper; its habits (breathing, locomotion, feeding, etc.).

A study of the main external features of the grasshopper to show its fitness for its mode of life. Life history of the grasshopper.

* A study of at least two other insects to show variation in external features, feeding habits and life histories (classification not required).

General characteristics of insects; rate of reproduction; natural control factors.

Harmful and beneficial insects. (Five periods).

A brief survey of insects injurious to plants, to animals, to household goods, and to man; nature of injury and methods of control.

* A brief survey of beneficial insects as scavengers, predators, pollinators, etc.

Social insects. (Five periods).

A study of the life history, habits and economic importance of the honey bee.

* A brief survey of other social insects.

Fungi

Bread mould. (Two periods).

Culture of bread mould and microscopic examination of the mycelium, sporangium and spores.

Mushroom. (Two periods).

The mushroom as a plant; vegetative and reproductive parts; mode of life; recognition of the common meadow mushroom and of the poisonous Amanita.

Yeast. (Two periods)

Culture of yeast in sugar solution and collection and identification of carbon dioxide; microscopic examination of yeast cells; economic importance.

Parasitic fungi. (Three periods).

A brief discussion of the widespread occurrence of blights, mildews, smuts, rusts, etc., and the injury they do to plants of economic importance.

* Recognition of one parasitic fungus and a study of its mode of life; methods of control; the role of fungicides.

Bacteria. (Five periods).

What they are and where they occur; beneficial and harmful kinds; laboratory demonstration by the use of Petri dishes and agar to show development of colonies of bacteria: experi-

ments to show (1) pasteurization of milk, (2) sterilization of milk and of canned foods: water pollution; purification of water by boiling: use of chloride of lime as a disinfecting agent; infectious diseases, e.g., tuberculosis, typhoid fever, diphtheria; discussion of agents of infection, such as house flies, drinking cups, etc.

The Heavens

(Eight periods). Instructions for the following observations should be given at the opening of school in September.

The Sun. Observation of the position of the sun (1) at different times of a single day, (2) at noon from week to week, (3) at sunrise and sunset from week to week: observation of the variation in the length and direction of shadow in (1) and (2).

The Moon. Observation of the position of the moon at different hours of a single evening: observation of its position and appearance at the same hour for successive evenings.

* Observation of the position of the full moon at rising and of the elevation of its path above the southern horizon at various seasons of the year.

The Stars. Observation of the position of the Great Dipper (1) at different hours in the same evening, (2) at the same hour in successive months: recognition of at least three other constellations: recognition of the Milky Way: observation of the position of the polar star.

* Recognition of at least three stars of first magnitude.

Planets. Recognition of two planets and observation of the change in position of one of them: observation with field glasses or opera glasses of four of the moons of Jupiter.

Meteors. Report of meteors observed during school year, with special attention to meteoric showers occuring in October, November, December and April.

NOTE: It is assumed that a total of eight periods during the school year will be required for the discussion of above observations.

Movements and distances of the heavenly bodies. (Two periods). The diurnal rotation of the earth, the annual revolution of the earth: the revolution of the moon about the earth; the rotation of the moon on its axis.

The solar system: explanation of apparent movements of heavenly bodies: distance relations of sun, moon, planets, stars.

The meaning of light year.

Shadows and eclipses. (Three periods). Rectilineal propagation of light: an experiment to show the formation of shadows (umbra and penumbra); explanation of solar and lunar eclipses.

Luminosity of heavenly bodies. (Three periods).

* Luminous and non-luminous bodies: difference between diffuse and regular reflection: explanation of luminosity of the moon, of the planets and of meteors: explanation of the appearance of the moon at different phases.

GRADE X

Energy

Heat units. (Four periods.)

Comparison of Fahrenheit and Centigrade scales by means of a graph.

An experiment to illustrate the meaning of quantity of heat: the distinction between quantity of heat and temperature: the calorie and the British thermal unit.

An experiment to show that different substances have different heat capacities: the importance of the high heat capacity of water in relation to climate.

Change of state. (Four periods.)

Experiments to show absorption of heat without change in temperature when ice melts and when water boils: the use of ice in refrigerating and of steam in heating.

An experiment to show cooling by evaporation: the principle of artificial refrigeration.

* A brief explanation of evaporation in terms of molecular motion.

Hygrometry. (Four periods.)

Recall the presence of water vapour in the air.

An experiment to determine dew-point.

Meaning of relative humidity; measurement of the relative humidity of the air in the class-room by means of the wet and dry bulb hygrometer and of the hair hygrometer.

Humidifiers: the meaning of air-conditioning.

Force and weight. (Three periods.)

Recall that the pressure of a liquid is due to weight (a force).

Consideration of other types of force such as muscular exertion, tension in a cord, friction, elasticity of a spring.

Demonstration of the measurement of force by the extension of a spring: the weight or pull of the earth on a mass of one pound or one gram as a unit of force: the spring balance.

The use of the units of weight for the measurement of non-gravitational forces.

Work, energy and power. (Nine periods.)

Simple experiment with the lever and the single fixed pulley to show the relation between force and load; the use of those machines to explain the meaning of work: the foot-pound as a unit of work.

The meaning of energy: a simple discussion of the various common forms of energy: kinetic and potential energy.

Illustrations of transformations of energy and the law of conservation of energy.

Recall the transformation of radiant energy into chemical energy in the phenomenon of photosynthesis.

* A discussion of the role of friction, its advantages and disadvantages.

A brief discussion of the production of heat energy: by combustion (transformation of chemical potential energy); by compression (transformation of kinetic energy); by friction (transformation of kinetic energy); by the impact of a moving

body (quick transformation of kinetic energy); by an electric current (transformation of electrical energy); by the absorption of radiation (transformation of radiant energy).

Experiments to illustrate as many of these as possible.

An elementary consideration of the development of mechanical energy by (a) the transformation of heat energy, as in the steam engine, (b) the transformation of gravitational potential energy, as in the water turbine; (c) the transformation of chemical potential energy, as in the gasoline engine.

The meaning of power: the horse-power in foot-pounds per minute.

Magnetism and Electricity

Magnetism. (Four periods.)

An experiment to show magnetic poles by the attraction of iron filings to a bar magnet.

An experiment to show the position of rest of a suspended or pivoted magnet.

Experiments to show magnetic attraction and repulsion and to identify the poles of a magnet.

The earth as a magnet; the magnetic compass.

* An experiment to show magnetization of a knitting needle by stroking with a bar magnet (reference to the transformation of a part of the kinetic energy used in this process into magnetic potential energy).

Static electricity. (Two periods.)

Experiments to show the electrification of ebonite rubbed with fur and of glass rubbed with silk (reference to the transformation of a part of the kinetic energy used on this process into electrical potential energy).

An experiment to show electrical attraction and repulsion and to show the two kinds of electrification.

An experiment to identify several electrical conductors and non-conductors.

Current electricity. (Nine periods.)

An experiment to show the production of a current, indicated by sparks between the terminals of a static machine (transformation of mechanical into electrical energy).

An experiment to show the production and detection of a current from a voltaic cell (reference to a transformation of chemical energy into electrical energy).

The dry cell as a special form of the voltaic cell

* Repeat the experiment on the electrolysis of water (reference to the transformation of electrical to chemical potential energy).

A brief discussion of the transformation of electrical energy into heat energy in the electric lamp, toaster, fuse, etc.

An elementary discussion of electrical units; volt, ampere, watt, kilowatt-hour in relation to common electrical appliances and in payment for electrical energy. Switches, fuses, short circuits, danger of "grounds" in household circuits.

GRADE X

Experiments to show the magnetic effect of an electric current (a) in the deflection of a compass needle, (b) in the electro-magnet.

Air

Composition of air. (Two periods.)

An experiment comparing the rusting of damp iron in air and in oxygen (obtained from cylinder or other source) showing (a) that oxygen is essential for the rusting of iron, (b) that oxygen is removed from air by this method, (c) that this experiment may be used to determine the approximate percentage by volume of oxygen and nitrogen in the air.

Combustion in oxygen and in air. (Five periods.)

* An experiment to show the combustion of iron in oxygen; comparison with the slow oxidation (rusting) of iron in air.

Experiments to show the combustion in oxygen of carbon (charcoal), sulphur, and magnesium; physical properties of the products.

Combustion of fuels: a chemical reaction (oxidation) producing heat energy; experiments to show by the production of carbon dioxide and water that fuels contain carbon and, in most cases, hydrogen; recall dripping of water from cold automobile exhaust pipes.

Discussion of the dangerous properties of combustible gases such as gasoline vapour, fuel oil vapour, and illuminating gas.

Protection from corrosion. (Two periods.)

(1) Surface coating: painting; galvanizing and tin-plating; electroplating (a simple experiment without theory).

* (2) Alloys: brief discussion of such non-corrosive alloys as stainless steel.

Carbon dioxide and weathering of rocks. (Four periods.)

An experiment to show (a) the solubility of carbon dioxide in water and (b) the effect of this solution on litmus. Compare the effect of other acids on litmus.

An experiment to show the action of a solution of carbon dioxide on a fine suspension of precipitated chalk in water; the application to the weathering of limestone.

Recall the hardness of water and, using the above solution, demonstrate (a) the cause of hardness of water, (b) the cause of deposition of scale in a kettle (due to loss of carbon dioxide).

Home and industrial uses of carbon dioxide. (One period.)

Its use in baking (obtained from baking soda and yeast).

Its use in carbonated beverages, fire extinguishers, and as dry ice.

The Composition and Classification of Foods

Water in foods. (Two periods.)

Experiments to show that foods contain water, and to show how the percentage of water may be determined in such foods as fresh vegetables, fresh fruits, cereals, butter.

GRADE X

Carbohydrates. (Four periods.)

An experiment to detect presence of starch in flour, potato etc. An experiment to contrast sugar with starch in respect to solubility and taste. An experiment to show the presence in starch of (1) carbon, (2) hydrogen and oxygen (as shown by the condensation of water).

An experiment to show the conversion of starch to sugar (a) by the action of saliva, (b) by boiling with dilute hydrochloric acid. (Note change in appearance, action on hot Fehling's solution or Benedict's solution.)

Fats. (Two periods.)

Experiments to show that fats (1) are insoluble in water, (2) are soluble in carbon tetrachloride, (3) produce a persistent greasy translucent spot on paper.

An experiment to detect the presence of fat in butter, nuts, cheese, whole milk, etc.

Proteins. (Two periods.)

Proteins contain nitrogen in addition to carbon, hydrogen and oxygen. Many different proteins occur in the bodies of plants and animals as protoplasm and stored products. Proteins vary greatly in some properties as shown in egg albumen, gluten, casein (cottage cheese) and milk albumen. Experiments to show (1) that proteins are characterized by a disagreeable odour on charring, (2) the spot test with nitric acid and ammonium hydroxide.

Mineral Salts. (Two periods.)

An experiment to show the presence of ash or mineral matter in such foods as rolled oats and potato, by gently burning to complete combustion.

The Combustion of common Foods. (Five periods.)

A discussion of the role of carbohydrates, proteins, fats, mineral salts, and water in the diet, and the relative proportions of the food constituents as listed above in such common foods as flour, rice, beans, honey, butter, lard, salad oil, peanut butter, meat, eggs, fish, cheese.

Experiments to show that milk contains (a) water, (b) sugar, (c) fat, (d) casein and albumen, (e) mineral matter; the value of milk as a food.

The role of vitamins; the value of fresh foods and a varied diet.

Fuels and foods. (Four periods.)

* A comparison of the calorific value of various fuels.

An experiment to show the production of heat and the formation of carbon dioxide by the burning of sugar.

A discussion of food as fuel and of the calorie equivalent of some common foods. The role of food in supplying energy for heat and work.

Recall photosynthesis, stressing the absorption of energy in a reaction which is the reverse of the oxidation of carbon-containing substances.

A discussion of the carbon cycle.

GRADE X

The Human Body

The Cell. (Two periods.)

Recall the structure of a plant cell. Microscopic observation of a simple cell such as cheek epithelium to show cell wall, cytoplasm and nucleus: growth (a) by increase in size of cells, (b) by increase in the number of cells (cell division).

The cell as an organism with the functions of nutrition, motility and secretion. (If possible the living amoeba or paramoecium should be examined by the pupils).

The meaning of tissues, organs, systems.

The Skeleton and movement. (Four periods.)

The main features of the human skeleton (names required for the long limb bones only).

The relations of muscles, tendons, skeleton, and nerves in producing movement, e.g., the action of the biceps.

Simple reflexes such as the knee-jerk, and the reaction of the iris to light. Voluntary motion.

Digestion and absorption (Two periods.)

The meaning of digestion; the alimentary canal; a brief discussion of digestive changes taking place in each of the parts; glands and juices taking part in these changes.

Absorption of digested food.

Circulation, respiration and excretion. (Seven periods.)

The blood and the lymph: observation of the circulation of blood in the web of a frog's foot or in a tadpole's tail; microscopic examination of a drop of blood diluted with physiological saline solution (0.9% common salt).

The constituents of the blood and their functions.

The circulation of the blood in the human body (names of arteries and veins not required); the changes taking place in the tissues, the kidneys and the lungs.

Protection from disease by the formation of antibodies.

An experiment to show that exhaled air contains more carbon dioxide than room air; the meaning of respiration (energy transformations).

The organs of breathing; the great surface area in the lungs; how breathing is carried on.

The danger of carbon monoxide poisoning.

* Reasons for ventilation.

The Aquarium and Aquatic Life

The Fish. (Four periods.)

A study of the living fish: its habits (breathing, locomotion, feeding, etc.); a study of the main external features of the fish to show its fitness for its mode of life.

Life history and breeding habits of fishes (at least two examples).

* Fish conservation: preservation of conditions suitable for various kinds, fish hatcheries, reasons for fishing regulations.

GRADE X

The Frog.
(Three periods.)

A study of the living animal: its habits, external features, life history.

The economic importance of frogs and toads.

Other forms of aquatic animals.

Pupils should be encouraged to make careful observations of the activities of other animals, such as clams, crayfish, turtles, water beetles, water larvae, etc.

Inter-relationship
(One period.)

The interdependence of water plants and water animals should be emphasized: water plants are used as food by water animals: these plants give off oxygen, some of which is dissolved in water and is used by animals in respiration.

Water animals produce carbon dioxide which in turn is used by aquatic plants.

The making of a balanced aquarium.

Birds

External features and activities.
(Four periods.)

Pupils should be encouraged to continue bird identification and bird-watching throughout the year.

* A study of a few common birds to show general characteristics and variation in external features. The relation of birds to man; protection of birds.

Balance in Nature

(Three periods.)

Interdependence of plants and animals. If there is no interference with natural conditions there comes about an approximate equilibrium (determined by the climate) among plants, herbivores and carnivores. Dominant vegetation: deciduous forests in S. Ontario, conifers in N. Ontario. Man disturbs this equilibrium in the following ways: (1) drainage of swamps —effect on plants, birds, and aquatic animals; (2) removal of forests—effect on certain birds and mammals; (3) cultivation of the soil—effect on plants, soil inhabiting organisms; (4) extermination of animals, e.g., passenger pigeon, buffalo; (5) introduction of new plants, purposely or accidentally—relation to insects and fungous diseases; (6) introduction of new animals, e.g., English sparrow, starling, European corn-borer, saw-fly, insect-predators.

REFERENCE BOOKS

General Science, Book Two.....J. M. Dent & Sons Ltd., Toronto

A Junior Science for Secondary Schools, Part Two.....Sir Isaac Pitman & Sons, Toronto

Elements of Physics.....The Copp Clark Co. Ltd., Toronto

Chemistry for High Schools.....W. J. Gage & Co., Toronto

Chemistry Manual.....W. J. Gage & Co., Toronto

Everyday Problems in Science.....W. J. Gage & Co., Toronto

Science in Daily Life.....Longmans Green & Co., Toronto

A Book of General Science.....The Macmillan Co. Ltd., Toronto

The World of Science.....The Ryerson Press, Toronto

AGRICULTURAL SCIENCE

Objectives:

(1) To develop an understanding and appreciation of the materials and natural phenomena in the pupils' environment.

(2) To develop a scientific interest in the problems and activities of rural life.

(3) To cultivate the pupils' powers of discriminating observation, critical thinking, accurate expression and relating cause and effect.

(4) To correlate the activities of school work with those of the farm and community.

The method of instruction should provide definite pupil activity in the examining of materials, performing experiments and in outdoor practical work. The project method should have a definite place in the teaching. Every pupil must complete a home project on a suitable topic approved by the teacher as a part of the work of Grades IX and X. This project should be selected in Grade IX.

Well supervised note-book work plays an important part in the training. The note-book should contain a neat and accurate record of the pupil's work, illustrated by suitable diagrams or pictures. These records should be a clear expression of the impressions gained from investigations and discussions.

A time allotment is given for each topic merely to indicate the "depth" of treatment intended. Teachers are expected to use discretion in the emphasis given to different topics and should not greatly exceed the time allotment suggested. In case some teachers have not sufficient time to cover the whole course, the topics which are marked optional may be omitted.

OUTLINE OF THE COURSE (Grade IX)

Note: Topics marked with an asterisk (*) are optional.

Autumn and Early Winter

The relationship of plants of man. (One period.)	A preliminary discussion which will serve to arouse the pupils' interest in plants and their relation to Agriculture.
Gardening and weed study. (Two periods.)	Autumn care of the garden; recognition of at least ten weeds mentioned in the Weed Control Act.
The living plant. (One period.)	Observation of the plant in its natural environment should precede class-room study. Variation in habit and the conditions (light and water) under which the plant grows should be noted.
The shoot and the root. (One period.)	The arrangement of leaves with relation to light; origin of flowers and branches from buds in the axils of leaves; general functions of flower, leaf, stem and root.
The parts of a flower and their functions. (Six periods.)	The shape and arrangement of the parts of two simple flowers, one with separate petals (e.g., buttercup, mustard), one with united petals (e.g., toadflax, petunia). Recognition that a composite flower is a group of florets each with united petals. A hand lens and a needle should be used in examining the stamens, pollen grains, pistil and ovules. (The use of scientific terms in reference to the relationship of parts is not expected.)

GRADE IX

Pollination and fertilzation. (Four periods.)

Insect pollination and wind pollination; floral structure, nectar, abundance of pollen, colour, odour, etc.

Examination of the bee to discover adaptations for the collection of pollen and nectar.

Simple explanation of fertilization.

Fruit and seed. (Six periods.)

A study of the bean fruit, including seed, to show the parts, their origin and their relationship to other parts of the plant and to the propagation of the plant.

A study of simple fleshy fruits such as the tomato, plum and apple. (Classification not expected).

Adaptation of plants for fruit and seed dispersal.

Composition, use and care of milk. (Seven periods.)

Composition of whole milk; milk as a complete food; examination of a drop of milk under the compound microscope to observe the fat globules; testing whole milk with the Babcock tester; value of this test in keeping individual cow records and as a basis of payment for milk; care of milk on the farm.

Winter and Early Spring

Preliminary discussion of relation of water to plant and animal life. (Two periods.)

Widespread distribution of water.

Experiment to show water in plant tissue and in animal tissue.

Water as necessary to plant and animal life.

Water as a habitat for plants and animals.

Brief discussion of water conservation.

Water in various states. (Four periods.)

Solids, liquids, gases.

Freezing of water, melting of ice and snow.

Observation of snow crystals or other crystals grown by the class as a home assignment.

Experiment to show steam from boiling water and condensation on a cold surface.

Experiment to show evaporation of water.

Formation of dew.

* Frosting of window and appearance of hoar (white) frost to illustrate sublimation.

* Experiment to show sublimation with benzoic acid.

Importance of water as a solid. (One period.)

Value of snow as a protecting cover for plants and as a means of water storage in nature.

Experiment to show expansion of water on freezing, as a home assignment; application to floating of ice and to disintegration of rocks and formation of soil.

GRADE IX

Importance of water as a gas. (Two periods.)

Experiment to show presence of water vapour in the atmosphere.

Experiment to show great expansion of water on vaporization: reference to the steam engine.

Water as a solvent. (Four periods.)

Distilled and ordinary water; an experimental illustration of the separation of water and dissolved solids by distillation.

Solution: experimental illustration of the relative solubility of solids.

* Saturated solutions.

The dissolving of air in water and its significance to aquatic life.

The cause of hardness in water.

An experimental illustration of the behaviour of hard water with soap.

Thermometers. (Three periods.)

Recall thermal expansion of matter in each of its three states.

Experiment to show thermal expansion of liquids.

Thermal expansion of liquids as a means of measuring change in temperature.

Use of freezing point and boiling point of water as fixed points in establishing a thermometric scale.

Compare Fahrenheit and Centigrade scales by reading temperatures in both scales.

Compare alcohol and mercury thermometers.

Clinical thermometers.

Dairy or hot bed thermometer.

Practice in measurement with metric units. (Four periods.)

Measurement of length in metres, centimetres, and millimetres: comparison of the kilometre and the mile.

The measurement of the area of a rectangular card and of the volume of a rectangular solid.

The measurement of the volume of a liquid.

* Proper use and care of the balance.

Measurement of the mass of a solid by use of a balance.

Density. (Two periods.)

Meaning.

Density of the solid used above.

Experimental determination of density of water.

Importance in nature of maximum density of water.

* Experimental demonstration of density of mercury.

Farm water supply. (Four periods.)

Source; protection from pollution.

Purification of water by boiling; use of chloride of lime.

GRADE IX

Pressure in liquids. (Two periods.)

Experiment to show that water exerts pressure.

Experiment to show that the pressure varies with the depth.

Experiment to show that the pressure is equal in all directions.

Recognition that the weight of a body is a force and that the pressure is due to weight.

The composition of water. (Three periods.)

* The analysis of water by electrolysis to show that it is composed of two gases identified as oxygen and hydrogen.

The composition of air. (Four periods.)

An experiment to show the rusting of iron in damp air; the properties and identity of the fraction of air removed and the fraction remaining.

Experimental illustration that atmospheric oxygen is necessary for combustion.

Experimental illustration of the production of carbon dioxide by (a) combustion of charcoal (carbon) in air, (b) respiration.

Demonstration of such properties of carbon dioxide as density, and effect upon a flame.

Importance of air. (One period.)

The atmosphere.

Air in soil: increase by cultivation and under-drainage.

The resistance of air to moving bodies.

Air pressure. (Three periods.)

Experiments to show that air occupies space and that air has weight.

Experiment to show that air exerts pressure.

Utilization of air-pressure as shown in such devices as fountain pen, common water-pump, and siphon (mechanical details of these not expected).

Measurement of atmospheric pressure. (Three periods.)

Construction of the mercury barometer: how it works.

Variation from day to day and from place to place.

* The height of a water barometer.

Observation of the aneroid barometer with practice in taking readings.

Its use to measure altitude shown by taking readings at different levels.

Compression and expansion of gases. (Two periods.)

Experimental demonstration of the compression and expansion of air.

Elementary discussion of the relationship of volume and pressure.

Compression of air in the bicycle or automobile tire, air-pump, air-gun, air tools, sand-blast (mechanical details not required).

GRADE IX

Convection in liquids (Two periods.)

Thermal expansion.

Experiment to show convection currents in water.

Hot-water heating system or the hot water incubator (simple notion of circulation only).

Convection in gases. (Three periods).

Experiment to show convection in air.

Air movement as illustrated in a hot-air heating system, in a heated room, and in a refrigerator: draught in a chimney.

Importance of ventilation.

Effects of water in motion. (One period).

Rain-wash and how it is combated on farm lands.

River erosion.

Wave erosion.

Deposition of sediment.

Effects of air in motion. (Two periods).

Sailing ships, windmills.

Soil drifting; how checked.

Sand dunes.

Rainfall and wind.

The work of the Meteorological Service. (Three periods.)

Isobars.

Relation of winds to isobars.

Weather maps.

High and low pressure areas with their winds and weather.

Breeds, incubation and management of chickens. (Ten periods.)

Recognition of at least six breeds of chickens kept in the locality; characteristics of the class to which they belong; hatching of chicks in the school incubator; brooding and rearing of chicks; housing and management of chickens; care of eggs.

Spring and Early Summer

Structure and function of the leaf. (Nine periods.)

Examination of leaf epidermis, including stomata.

Examination of a cross-section of a leaf to show arrangement of the cells and cell structure.

Experiment to show the iodine test for starch.

Experiment to show that starch is made in green leaves in the light and disappears in the dark.

Experiment to show the presence of starch in seeds and tubers etc.

The use of an aquatic green plant to show the exhalation of oxygen in bright light; the need for carbon dioxide in the process, e.g., comparison of effect with (a) boiled water, (b) boiled water with carbon dioxide added.

Experiment to show transpiration in green plants.

Growth, structure and function of the stem. (Four periods.)

A study, over a period of time, of a growing bean plant or of green twigs to show the increase in length due to primary growth at or near the tip.

GRADE IX

Examination of a green twig to show (a) the location and nature of the cambium layer, (b) that in the older part of the twig there is a greater thickness due to the activity of the cambium (secondary growth).

Examination of a cross-section of oak or other tree trunk to discover: pith, heartwood, sapwood, rays, cambium, outer and inner bark.

Demonstration of the rise of water in stems.

Absorption by roots. (Five periods.)

Experiment to show the presence of mineral salts in solution in soil water.

Observation of the development of root hairs in germinating seeds.

* Demonstration of diffusion of a gas in air and of a dissolved salt in a liquid.

Simple experiments illustrating the absorption of water with salts in solution through membranes and the significance of this in absorption by roots.

Methods and practice of gardening. (Five periods.)

Planning and preparation of the school or home garden.

Preparation, care and uses of the hot bed and cold frame.

Methods of growing early vegetables such as potatoes, onions, rhubarb, lettuce, cabbage, tomatoes.

Methods of growing annual and perennial flowers.

REFERENCE BOOKS

The reference books listed for the course in general science should be used for the corresponding topics in agricultural science. The following are recommended for other topics:

Dairying, Farm and Factory. Dean. The Ryerson Press, Toronto.

Poultry Production. Lippincott and Card (Fifth Edition). Lea and Febiger, Philadelphia.

The Garden Guide. The General Publishing Company, Toronto.

Bulletins of the Ontario Department of Agriculture, Toronto, and the Dominion Department of Agriculture, Ottawa.

OUTLINE OF THE COURSE (Grade X)

Note: Topics marked by an asterick (*) are optional.

Preview of world's greatest industry. (One period.)

Compare the nature of early farming in Canada with that of to-day. Discuss (1) the necessity of scientific knowledge and practice in Agriculture, (2) the dependence of other occupations on Agriculture.

The five great plant groups of farm, garden and orchard. (One period.)

Observe important members of the five different farm and garden crops, namely grass, legume, root and tuber, fleshy fruit and leaf plants; recognition of habit of growth that makes each valuable.

Full care of garden. (Two periods.)

Recognition and destruction of weeds in the garden; harvesting, storage or disposal of crops; sowing of fall rye (or wheat) as a green manure crop; fall cultivation.

Plant propagation. (Five periods.)

Discussion and practical demonstration **in season** of the following: (a) vegetative reproduction as shown in the growing of strawberry, potato, raspberry, geranium (from slips or cuttings), (b) planting and pruning of trees and shrubs; grafting and budding of trees and shrubs; (c) methods of growing flowering bulbs for outdoor and indoor bloom.

Note: Part of the above work will be taken in gardening periods in the spring.

Insects

Habits, structure and life history of the grasshopper. (Three periods.)

A study of the living grasshopper; its habits (breathing, locomotion, feeding, etc.).

A study of the main external features of the grasshopper to show its fitness for its mode of life. Life history of the grasshopper.

General characteristics of common orders of insects. (Four periods.)

A comparison of the mouth parts, wings and metamorphoses of insects belonging to each of the following orders: Orthoptera, (e.g., grasshopper, cricket); Odonata (e.g., dragon fly, damsel fly); Hemiptera (e.g., squash bug, stink bug); Homoptera (e.g., aphids, cicada); Coleoptera (e.g., potato beetle, lady-bird beetle); Lepidoptera (e.g., cabbage butterfly, sphinx moth); Diptera (e.g., housefly, mosquito); Hymenoptera (e.g., ant, ichneumon fly).

Characteristics common to all insects: i.e., three pairs of legs; three parts to the body; the life history a metamorphosis: rate of reproduction of one or two common insects.

Note:—Collection by each pupil of one specimen of each of the above orders. This work should be assigned in June of the previous school year.

Harmful and beneficial insects. (Four periods.)

A brief survey of insects injurious to plants, to animals, to household goods and to man (at least two examples in each case); nature and extent of injury; natural control factors; man's control.

* A brief survey of beneficial insects as scavengers, predators, pollinators, etc.

GRADE X

Beekeeping. (Five periods.)

The bee as an example of a social insect: study of the queen, drone and worker; their development and activity in the colony: examination and uses of the parts of a Langstroth hive: seasonal care of bees: causes and control of swarming: nectar producing plants.

Fungi

Bread mould. (Two periods.)

Culture of bread mould and microscopic examination of the mycelium, sporangium and spores.

Mushroom. (Two periods.)

The mushroom as a plant; vegetative and reproductive parts, mode of life: recognition of the common meadow mushroom and of the poisonous Amanita, the puff ball and the polypore.

Yeast. (Two periods.)

Culture of yeast in sugar solution and collection and identification of carbon dioxide; microscopic examination of yeast cells; economic importance.

Plant diseases. (Five periods.)

A brief discussion of the widespread occurrence of blights, mildews, smuts, rusts, etc., and the injury they do to plants of economic importance (at least one example of each to be observed).

Recognition and mode of life of three parasitic fungi causing any three of the following diseases: apple scab, potato scab, black knot, corn smut; methods of control; the role of fungicides.

Bacteria. (Five periods.)

What they are and where they occur: beneficial and harmful kinds: laboratory demonstration by the use of Petri dishes and agar to show development of colonies of bacteria: experiments to show (1) pasteurization of milk, (2) sterilization of milk and of canned foods: water pollution; purification of water by boiling: use of chloride of lime as a disinfecting agent; infectious diseases, e.g., tuberculosis, typhoid fever, diphtheria; discussion of agents of infection, such as house flies, drinking cups, etc.

Live Stock

(Ten periods.)

Types and common breeds of cattle, of sheep, of swine, and breeds of draught horses. Explanation of the terms; pedigreed stock and grade stock; disadvantages of keeping scrub stock.

Energy

Heat units. (Four periods.)

Comparison of Fahrenheit and Centigrade scales by means of a graph.

An experiment to illustrate the meaning of quantity of heat: the distinction between quantity of heat and temperature: the calorie and the British thermal unit.

An experiment to show that different substances have different heat capacities: the importance of the high heat capacity of water in relation to climate.

GRADE X

Change of state. (Four periods).

Experiments to show absorption of heat without change in temperature when ice melts and when water boils: the use of ice in refrigerating and of steam in heating.

An experiment to show cooling by evaporation: the principle of artificial refrigeration.

* A brief explanation of evaporation in terms of molecular motion.

Hygrometry. (Four periods).

Recall presence of water vapour in the air.

An experiment to determine dew-point.

Meaning of relative humidity; measurement of the relative humidity of the air in the class room by means of the wet and dry bulb hygrometer and of the hair hygrometer.

Humidifiers: the meaning of air conditioning.

Force and weight. (Three periods).

Recall that the pressure of a liquid is due to weight (a force).

Consideration of other types of force such as muscular exertion, tension in a cord, friction, elasticity of a spring.

Experimental measurement of force by the extension of a spring: the weight or pull of the earth on a mass of one pound or one gram as a unit of force: the spring balance.

The use of the units of weight for the measurement of non-gravitational forces.

Work, energy and power. (Nine periods).

Simple experiments with the lever and the single fixed pulley to show the relation between force and load; applications in farm appliances; the use of these machines to explain the meaning of work: the foot-pound as a unit of work.

The meaning of energy: a simple discussion of the various common forms of energy: kinetic and potential energy.

Illustrations of transformations of energy and the law of conservation of energy.

Recall the transformation of radiant energy into chemical energy in the phenomenon of photosynthesis.

* A discussion of the role of friction, its advantages and disadvantages.

A brief discussion of the production of heat energy: by combustion (transformation of chemical potential energy); by compression (transformation of kinetic energy); by friction (transformation of kinetic energy); by the impact of a moving body (quick transformation of kinetic energy); by an electric current (transformation of electrical energy); by the absorption of radiation (transformation of radiant energy).

Experiments to illustrate as many of these as possible.

An elementary consideration of the development of mechanical energy by (a) the transformation of heat energy, as in the steam engine; (b) the transformation of gravitational potential energy, as in the water turbine; (c) by the trans-

formation of chemical potential energy, as in the gasoline engine.

The meaning of power: the horse-power in foot-pounds per minute

Magnetism and Electricity

Magnetism. (Four periods.)

A demonstration of magnetic poles by the attraction of iron filings to a bar magnet.

A demonstration of the position of rest of a suspended or pivoted magnet.

Experiments to show magnetic attraction and repulsion and to identify the poles of a magnet.

The earth a magnet; magnetic compass.

* An experiment to show magnetization of a knitting needle by stroking with a bar magnet (reference to the transformation of a part of the kinetic energy used in this process into magnetic potential energy).

Experiments to show the electrification of ebonite rubbed with fur and of glass rubbed with silk (reference to the transformation of a part of the kinetic energy used in this process into electrical potential energy).

Static electricity. (Two periods.)

An experiment to demonstrate electrical attraction and repulsion and to show the two kinds of electrification.

Current electricity. (Nine periods.)

An experiment to identify several electrical conductors and non-conductors.

An experiment to show the production of a current, indicated by sparks between the terminals of a static machine (transformation of mechanical into electrical energy).

An experiment to show the production and detection of a current from a voltaic cell (reference to a transformation of chemical energy into electrical energy).

The dry cell as a special form of the voltaic cell.

* Repeat the experiment on the electrolysis of water (reference to the transformation of electrical to chemical potential energy).

A brief discussion of the transformation of electrical energy into heat energy in the electric lamp, toaster, fuse, etc.

An elementary discussion of electrical units; volt, ampere, watt, kilowatt-hour in relation to common electrical appliances and in payment for electrical energy.

Switches, fuses, short circuits, danger of "grounds" in household circuits.

Experiments to show the magnetic effect of an electric current (a) in the deflection of a compass needle; (b) in the electro-magnet.

GRADE X

Soils

Collection and storage of soil samples. (One period.)

Collection of three or four different kinds of soil early in the fall for winter study.

Origin and formation of soils. (Two periods.)

Discussion of the origin of soils; the part of physical and chemical agencies in formation of soil: an experiment to show the physical composition of a loamy soil: classification of soils according to size of particles.

Properties of soil. (Three periods.)

Discuss meaning of light and heavy soils; test samples for degree of stickiness when wet and condition upon drying.

An experiment to show the relation of soil moisture to soil temperature.

An experiment to show the relation of soil colour to (1) soil temperature (2) plant growth.

An experiment to test the effect of freezing and thawing upon soil granulation: reference to illustration in fall ploughing.

Soil moisture. (Five periods.)

Experiments to show the nature of (1) gravitational water, (2) capillary water, (3) hygroscopic water.

An experiment to compare the water-holding capacity and rapidity of percolation in dry sand, clay, and muck or rich loam.

An experiment to show how soil moisture may be conserved by a mulch; discussion of the application to farming and gardening.

An experiment to show soil porosity and the presence of soil air in loamy soil; discussion of the importance of air in soil for germination of seeds, the growth of roots, and the functioning of beneficial bacteria.

Recall experiment to show the presence of soluble matter in soil: discuss its relation to plant growth.

Organic matter in soils. (Two periods.)

Experiment to determine the relative amounts of organic matter in (1) loam, (2) clay, (3) sand, (4) muck.

Discuss the benefits of organic matter in soil and the role of soil bacteria.

Soil erosion and drifting. (One period.)

Discuss the causes of soil erosion and drifting and the means of prevention.

Air

Combustion in oxygen and in air. (Five periods.)

* An experiment to show the combustion of iron in oxygen: comparison with slow oxidation (rusting) of iron in air.

Experimental illustration of the combustion in oxygen of carbon (charcoal), sulphur, and magnesium; pyhsical properties of the products and their solutions to identify acids and bases by their action on litmus paper.

GRADE X

Combustion of fuels: a chemical reaction (oxidation) producing heat and energy: experiments to show by the production of carbon dioxide and water, that fuels contain carbon and hydrogen: recall dripping of water from cold automobile exhaust pipes.

Discussion of the dangerous propreties of combustible fuels and gases such as gasoline vapour, fuel oil vapour and illuminating gas.

Protection from corrosion. (Two periods.)

(1) Surface coating: (a) use of paint and oil (care of farm machinery), (b) galvanizing and tin-plating, (c) electroplating: (a simple experiment without theory).

* (2) Alloys: brief discussion of such non-corrosive alloys as stainless steel.

Carbon dioxide and weathering of rocks. (Five periods.)

An experiment to show (a) the solubility of carbon dioxide in water, (b) the effect of this solution on litmus.

Compare the effect of other acids on litmus.

A demonstration of the action of a solution of carbon dioxide on a fine suspension of precipitated chalk in water; the application to weathering of limestone.

Recall the hardness of water and using the above solution, demonstrate (a) the cause of hardness of water, (b) the cause of deposition of scale in a kettle (due to loss of carbon dioxide).

Home and industrial uses of carbon dioxide. (One period.)

Its use in baking (obtained from baking soda and yeast).

Its use in carbonated beverages, fire extinguishers and dry ice.

Acidity and Fertility of Soils

Tests for acidity. (Four periods.)

Tests for acidity in soils; (1) litmus, (2) reacto-soil test; reference to the effect of soil acidity on plant growth; cause of soil acidity and the correction; drainage; adding lime.

The Maintenance of fertility. (Four periods.)

The importance of the soil as a source of plant nutrients: recall the composition of air and water and discuss the components of soil.

A brief discussion of losses of plant nutrients from a soil by leaching and cropping.

Methods of replacing plant nutrients by (1) the use of barnyard manure, (2) application of commercial fertilizers, (3) turning under of green crops (green manure).

Elementary discussion of the meaning and value of crop rotation.

The Composition and Classification of Foods

Water in foods. (Two periods.)

Experiments to show that foods contain water, and to show how the percentage of water may be determined in such foods as fresh vegetables, fresh fruits, cereals, butter.

GRADE X

Carbohydrates. (Four periods.)

An experiment to detect presence of starch in flour, potato, etc. An experiment to contrast sugar with starch in respect to solubility and taste. An experiment to show the presence in starch of (1) carbon, (2) hydrogen and oxygen (as shown by the condensation of water).

An experiment to show the conversion of starch to sugar (a) by the action of saliva, (b) by boiling with dilute hydrochloric acid. (Note change in appearance, action on hot Fehling's solution or Benedict's solution).

Fats. (Two periods)

Experiments to show that fats (1) are insoluble in water, (2) are soluble in carbon tetrachloride, (3) produce a persistent greasy translucent spot on paper.

An experiment to detect the presence of fat in butter, nuts, cheese, whole milk, etc.

Proteins. (Two periods.)

Proteins contain nitrogen in addition to carbon, hydrogen and oxygen. Many different proteins occur in the bodies of plants and animals as protoplasm and stored products.

Proteins vary greatly in some properties as shown in egg albumen, gluten, casein (cottage cheese) and milk albumen.

Experiments to show that (1) proteins are characterized by a disagreeable odour on charring, (2) the spot test with nitric acid and ammonium hydroxide.

Mineral salts. (Two periods.)

An experiment to show the presence of ash or mineral matter in such foods as rolled oats and potato, by gently burning to complete combustion.

The combustion of common foods. (Five periods.)

A discussion of the role of carbohydrates, proteins, fats, mineral salts and water in the diet, and the relative proportions of the food constituents as listed above in such common foods as flour, rice, beans, honey, butter, lard, salad oil, peanut butter, meat, eggs, fish, cheese.

Recall experiments to show that milk contains (a) water, (b) sugar, (c) fat, (d) casein and albumen, (e) mineral matter: the value of milk as a food.

The role of vitamins; the value of fresh foods and a varied diet.

* A comparison of the calorific value of various fuels.

Fuels and foods. (Four periods.)

An experiment to show the production of heat and the formation of carbon dioxide by the burning of sugar.

A discussion of food as fuel and the calorie equivalent of some common foods. The role of food in supplying energy for heat and work.

Recall photosynthesis, stressing the absorption of energy in a reaction which is the reverse of the oxidation of carbon-containing substances.

A discussion of the carbon cycle.

Application to feeds for farm animals. (Two periods.)

Discussion of the importance of carbohydrates, fats, proteins, mineral matter in feeds for farm animals.

Distinction between roughage and concentrate feeds.

The Human Body

The Cell. (Two periods.)

Recall the structure of a plant cell.

Microscopic observation of a simple cell such as cheek epithelium to show cell wall, cytoplasm and nucleus: growth: (a) by increase in size of cells, (b) by increase in the number of cells (cell division).

The cell as an organism with the functions of nutrition, motility and secretion. (If possible the living amoeba or paramoecium should be examined by the pupils).

The meaning of tissues, organs, systems.

The skeleton and movement. (Four periods.)

The main features of the human skeleton (names required for the long limb bones only).

The relations of muscles, tendons, skelton and nerves in producing movement, e.g., the action of the biceps.

Simple reflexes such as the knee-jerk, and the reaction of the iris to light. Voluntary motion.

Digestion and absorption. (Two periods.)

The meaning of digestion; the alimentary canal; a brief discussion of digestive changes taking place in each of the parts; glands and juices taking part in these changes.

Absorption of digested food.

Circulation, respiration and excretion. (Seven periods.)

The blood and the lymph: observation of the circulation of blood in the web of a frog's foot or in a tadpole's tail; microscopic examination of a drop of blood diluted with physiological saline solution (0.9% common salt).

The constituents of the blood and their functions.

The circulation of the blood in the human body (names of arteries and veins not required); the changes taking place in the tissues, the kidneys and the lungs.

Protection from disease by the formation of anti-bodies.

An experiment to show that exhaled air contains more carbon dioxide than room air; the meaning of respiration (energy transformations).

The organs of breathing; the great surface area in the lungs; how breathing is carried on.

The danger of carbon monoxide poisoning.

* Reasons for ventilation.

Comparison with domestic animals. (Two periods.)

A brief discussion of the skeletal structure, the digestive system, the circulatory system and the respiratory system of farm animals as illustrated in the horse and the cow.

GRADE X

Birds

External features and activities. (Four periods.)

Pupils should be encouraged to continue bird identification and bird-watching throughout the year.

* A study of a few common birds to show general characteristics and variation in external features. The relation of birds to Agriculture; protection of birds.

Balance in Nature

(Three periods.)

Interdependence of plants and animals. If there is no interference with natural conditions there comes about an approximate equilibrium (determined by the climate) among plants, herbivores and carnivores. Dominant vegetation: deciduous forests in S. Ontario, conifers in N. Ontario. Man disturbs this equilibrium in the following ways: (1) drainage of swamps—effect on plants, birds, and aquatic animals; (2) removal of forests—effect on certain birds and mammals; (3) cultivation of the soil—effect on plants, soil, inhabiting organisms; (4) extermination of animals, e.g., passenger pigeon, buffalo; (5) introduction of new plants, purposely or accidentaly—relation to insects and fungous diseases; (6) introduction of new animals, e.g., English sparrow, starling, European corn-borer, saw-fly, insect-predators.

Methods and Practice in Gardening

(Eight periods.)

Planning, preparation and planting of plots of vegetables or farm crops in the home or school garden .

Discussion of methods of planting and care of fruit trees, bush fruits, flowering shrubs, annual and perennial flowering plants and *practice* in planting in the school garden; making and caring for a lawn.

Home Project Activities

Each pupil should complete at least one project before the end of the second year. In many cases the project may be commenced in Grade IX and completed in Grade X. The teacher should encourage selection of projects suited to the experience and ability of the pupil. Boys and girls from farm homes should select projects related to growing of crops and other farm activities. All projects should be supervised by the teacher and visits be made during the summer to homes where projects on growing crops or raising live stock are in progress. A suitable report should be required of all pupils.

The following is a suggested list of projects which can be varied and enlarged to suit local requirements:

GRADE X

1. Management of a home garden of flowers and vegetables.
2. Improvement of home grounds.
3. Construction and care of a hot bed.
4. Management of a colony of bees.
5. Incubation and rearing chickens.
6. Crate fattening of poultry.
7. Canning fruit or vegetables.
8. Growing plots of farm crops; grains, potatoes, root crops, tomatoes, etc.
9. Keeping a record of egg production and cost of feed for a flock for two or three months.
10. Keeping records of milk production from one or more cows for two or three months.
11. Keeping a record of feeding costs of farm animals.
12. Membership and activity in a Potato Club: Foal Club, Swine Club, Calf Club, Grain Club, or Home Canning Club.
13. Experiments to show the effect of the use of commercial fertilizers.
14. Collection of 100 insects.
15. Colection of 40 weeds and 6 grasses.
16. Collection of 20 weed seeds.
17. Survey of breeds of live stock, varieties of grains or types of crop rotation on farms in the locality.
18. Reports on industrial or manufacturing practices concerned with agricultural products.
19. Planting and growing of flowering bulbs.
20. Making a chart showing prices of farm products over a given period.

GRADE X

REFERENCE BOOKS

The reference books used for the course in general science should be used for the corresponding topics in agricultural science. The following are recommended for other topics:

Elementary Entomology. Sanderson and Jackson. Ginn and Company, New York.

Manual of Plant Diseases. Heald. McGraw-Hill Book Company, New York.

Beekeeping. Phillips. Macmillan Company, Toronto.

Agricultural Bacteriology. Russell and Hastings. The Century Company, New York.

or

Bacteria. Yeasts and Moulds in the Home. Conn. Ginn and Company, New York.

Types and Breeds of Farm Animals. Plumb. Ginn and Company, New York.

Canadian Agriculture for High Schools. Macmillan Company, Toronto.

Agriculture for High Schools. Andrews. W. J. Gage and Company, Toronto.

Bulletins of the Ontario Department of Agriculture, Toronto, and the Dominion Department of Agriculture, Ottawa.